

New Hampshire Volunteer Lake Assessment Program

2003 Biennial Report for Shellcamp Pond Gilmanton



NHDES
Water Division
Watershed Management Bureau
29 Hazen Drive
Concord, NH 03301



OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **SHELLCAMP POND, GILMANTON**, the program coordinators have made the following observations and recommendations:

Welcome back to the New Hampshire Volunteer Lake Assessment Program! As your group continues to participate in VLAP over the years, the database created for your lake/pond will help your monitoring group track water quality trends and will ultimately enable your group and DES to identify potential sources of pollutants from the watershed that may affect lake/pond quality.

As a rule of thumb, *please* try to sample at least once per month during the summer months (June, July, and August). In addition, it may be necessary to conduct rain event sampling at multiple locations along a stream using the bracketing technique to pinpoint sources of pollution. Furthermore, baseline studies could involve bi-weekly or monthly sampling for an extended period of time. DES will let you know if this type of sampling is appropriate.

We understand that future sampling will depend upon volunteer availability, your group's water monitoring goals and funding availability. We would like to point out that **water quality trend analysis is not feasible with only a few data points**. It will take many years to develop a statistically sound set of water quality baseline data. Specifically, after 10 consecutive years of participation in the program, we will be able to analyze the in-lake data with a simple statistical test to determine if there has been a significant change in the annual mean chlorophyll-a concentration, Secchi-disk transparency reading, and phosphorus concentration. Therefore, frequent and consistent sampling will ensure useful data for future analyses.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 ug/L.**

The current year data (the top graph) show that the chlorophyll-a concentration **increased** from June to July, and then **decreased greatly** from July to August. The chlorophyll-a concentration in July (8.04 mg/m³) was **greater than** the state mean.

The historical data (the bottom graph) show that the 2003 chlorophyll-a mean is **slightly less than** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows **an increasing** in-lake chlorophyll-a trend, meaning that the concentration has **worsened** since monitoring initially began in 1991. However, please note that the pond was not sampled from 1992 to 2000, and was also not sampled in 2002. In 1991, the chlorophyll concentration was 4 mg/m³. During the 2000, 2001, and 2003 sampling seasons, the chlorophyll concentration ranged between 5 and 8 mg/m³. After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began.

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

The current year data (the top graph) show that the in-lake transparency **remained relatively stable** from June to August.

Overall, visual inspection of the historical data trend line (the bottom graph) shows **a relatively stable** trend for in-lake transparency. Specifically, since monitoring originally began in 1991, the transparency has ranged between approximately 1.5 and 2.5 meters. Again, please remember that this trend is based upon four non-consecutive sampling seasons. As discussed previously, after 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a

lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration **increased very slightly** from June to August. (Please note that a phosphorus sample was not collected from the epilimnion on the July sampling event.) The phosphorus concentration in June and August was **greater than** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration in July was **greater than** the state median. (Please note that a phosphorus sample was not collected from the hypolimnion on the June or August sampling events.)

We understand that your monitoring group has chosen to conduct phosphorus sampling on a limited basis each sampling season. Therefore, we recommend that your group sample the epilimnion (1 meter) consistently on each sampling event.

Overall, visual inspection of the historical data trend line for the epilimnion shows a **relatively stable** phosphorus trend which is slightly **greater than** the state median. Specifically, the phosphorus concentration in the epilimnion has ranged between approximately 16 and 18 ug/L since monitoring originally began in 1991.

Overall, visual inspection of the historical data trend line for the hypolimnion shows a **slightly increasing** phosphorus trend, which means that the concentration has **slightly worsened** since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

➤ **Table 2: Phytoplankton**

Table 2 (Appendix B) lists the current and historic phytoplankton species observed in the lake/pond. The dominant phytoplankton species observed this year were ***Dinobryon* (golden-brown algae), *Asterionella* (a diatom), and *Rhizosolenia* (a diatom).**

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire’s less productive lakes and ponds.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire’s lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the “Chemical Monitoring Parameters” section of this report.

The mean pH at the deep spot this season ranged from **6.59** in the hypolimnion to **6.55** in the epilimnion, which means that the water is ***slightly acidic***.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 (Appendix B) presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean ANC value for New Hampshire’s lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are “highly

sensitive” to acidic inputs. For a more detailed explanation, please refer to the “Chemical Monitoring Parameters” section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper mean annual ANC this season was 5.47 mg/L, which indicates that the pond is **critically sensitive** to acidic inputs (such as acid precipitation).

➤ **Table 6: Conductivity**

Table 6 (Appendix B) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire’s lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the “Chemical Monitoring Parameters” section of this report.

The conductivity has **increased** in the lake/pond and inlets since monitoring began. Specifically, the annual mean epilimnetic conductivity this season was 161.8 uMhos/cm, which is the **highest** annual mean that has been measured in this location since monitoring initially began in 1991. In addition, the conductivity in the **Inlet** and **Inlet 2** continued to be elevated. Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity.

We recommend that your monitoring group conduct a shoreline conductivity survey. This survey may help to pinpoint the sources of elevated conductivity around the lake.

For a detailed explanation on how to conduct a shoreline conductivity survey, please contact the VLAP Coordinator.

➤ **Table 8: Total Phosphorus**

Table 8 (Appendix B) presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae’s ability to grow and reproduce. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Your monitoring group has chosen to conduct phosphorus sampling on a limited basis each sampling season. Therefore, the inlets were not tested for phosphorus this season. Since the phosphorus concentration in the lake is partially influenced by the amount of phosphorus that flows into the lake from the watershed, it is generally a good idea to sample the major tributaries to the lake for phosphorus, particularly during periods of high water (such as during the spring soon after snow melt and also during storm events).

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The dissolved oxygen concentration was **high** at all depths sampled at the deep spot of the lake/pond. Typically, shallow lakes and ponds that are not deep enough to stratify into more than one or two layers will have relatively high amounts of oxygen at all depths. This is due to continual lake mixing and diffusion of oxygen into the bottom waters induced by wind and wave action.

➤ **Table 11: Turbidity**

Table 11 (Appendix B) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

The turbidity in the **Inlet** sample was slightly elevated on the **August** sampling date which suggests that the stream bottom may have been disturbed while sampling or that erosion is occurring in this portion of the watershed.

When the stream bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting samples in the inlets, please be sure to sample where there the stream is flowing and where the stream is deep enough to collect a “clean” sample.

If you suspect that erosion is occurring in this portion of the watershed, we recommend that your monitoring group conduct

stream surveys and storm event sampling along this inlet. This additional sampling may allow us to determine what is causing the elevated levels of turbidity.

For a detailed explanation on how to conduct rain event and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic Article", or contact the VLAP Coordinator.

➤ **Table 12: Bacteria (*E.coli*)**

Table 12 lists the current year data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful disease-causing organisms may also be present.

The *E.coli* concentration was **low** (20 counts per 100 mL or fewer) at each of the sites tested this season. We hope this trend continues!

If you are concerned about bacteria levels in the beach locations, we recommend that your monitoring group conduct *E.coli* testing next season on a weekend during heavy beach use or after a rain event. Since *E.coli* die quickly in cool pond waters, testing is most accurate and most representative of the health risk to bathers when the source (humans, animals, or waterfowl) is present.

➤ **Additional Observations:**

During early July of 2003, there was a massive die-off of freshwater mussels in Shellcamp Pond. Hundreds of dead and decaying mussels were observed floating on the surface of the pond. In addition, dead snails were found along the shoreline. DES' concluding theory is that late-fall early-winter drawdown of the lake for weed control killed the mussels. During this period, the lake was apparently lowered quickly by approximately five feet (a typical drawdown for Shellcamp Pond is two feet).

It is likely that mussels in up to five foot depths were left stranded in the mud without water-cover. Consequently, the mussels in this zone must have frozen before water was added to the pond. The mussels were likely preserved all winter until the warm spring and early summer water temperatures promoted tissue decay. Gas generated by the decomposing tissue likely caused the mussels to float to the surface of the pond in early July.

In mid-July, DES biologists speculated that there were probably live

OBSERVATIONS AND RECOMMENDATIONS

2003

mussels and snails in the deeper part of the lake that were not affected by the drawdown. On September 22, 2003, two DES biologists used scuba gear to explore the deep water. They explored the south end of the pond near the island. Many live mussels were found in water that was seven to nine feet deep, and also at deeper depths. However, the biologists could not see any mussels closer to shore around the island. This is the area that would have been exposed to the air during the drawdown. Biologists also observed snails on plants in the pond.

DES believes that there are sufficient snail and mussel survivors to repopulate the lake in a few years.

In the future, the pond should not be drawn down past the two foot mark unless it occurs slowly so that the organisms in the lake have time to relocate and adjust to new water levels.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your lake/pond, the biologist conducted a "Sampling Procedures Assessment Audit" for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor's Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling

techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did a **very good** job when collecting samples this season! Specifically, the members of your monitoring group followed the majority of the proper field sampling procedures when collecting and submitting samples to the laboratory. However, the laboratory did identify one aspects of sample collection that the volunteer monitors could improve upon.

- **Sample Labeling:** Please make sure to label your samples with a waterproof pen (a black sharpie permanent marker works best), preferably before sampling. Make sure that the ink does not wash off the bottle when exposed to water. Thank you!

NOTES

- **Monitor's Note (8/20/03):** Several small algae blooms near Inlet #2, soft rush growth greater than normal

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, ARD-32, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/ard/ard-32.htm.

Aquarium Plants and Animals: Don't leave them stranded. Informational pamphlet sponsored by NH Fish and Game, Aquaculture Education and Research Center, and NHDES (603) 271-3505.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, NHDES-WD 97-8, NHDES Booklet, (603) 271-3503.

A Boater's Guide to Cleaner Water, NHDES pamphlet, (603) 271-3503.

Camp Road Maintenance Manual: A Guide for Landowners. Kennebec Soil and Water Conservation District, 1992, (207) 287-3901.

Comprehensive Shoreland Protection Act, RSA 483-B, WD-SP-5, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-5.htm.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm.

OBSERVATIONS AND RECOMMENDATIONS

2003

Erosion Control for Construction in the Protected Shoreland Buffer Zone, WD-SP-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-1.htm

Impacts of Development Upon Stormwater Runoff, WD-WQE-7, NHDES Fact Sheet, (603) 271-3503, or www.des.state.nh.us/factsheets/wqe/wqe-7.htm

Iron Bacteria in Surface Water, WD-BB-18, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-18.htm

Is it Safe to Eat the Fish We Catch? Mercury and Other Pollutants in Fish, NH Department of Health and Human Services pamphlet, 1-800-852-3345, ext. 4664.

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, WD-BB-9, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

Swimmers Itch, WD-BB-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-2.htm.

Through the Looking Glass: A Field Guide to Aquatic Plants. North American Lake Management Society, 1988, (608) 233-2836 or www.nalms.org.

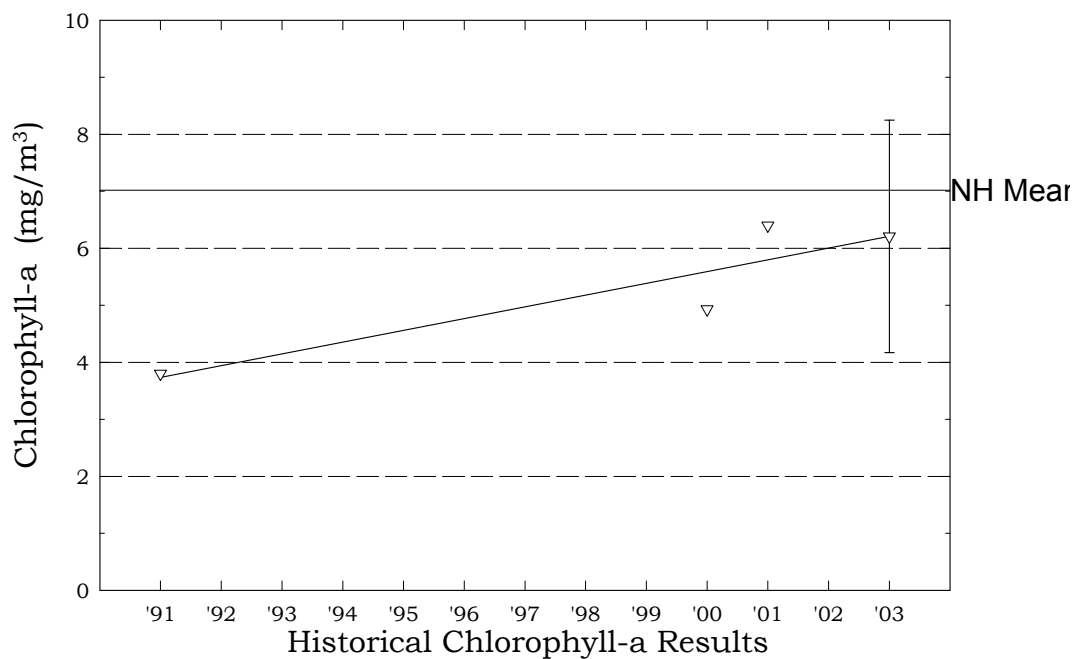
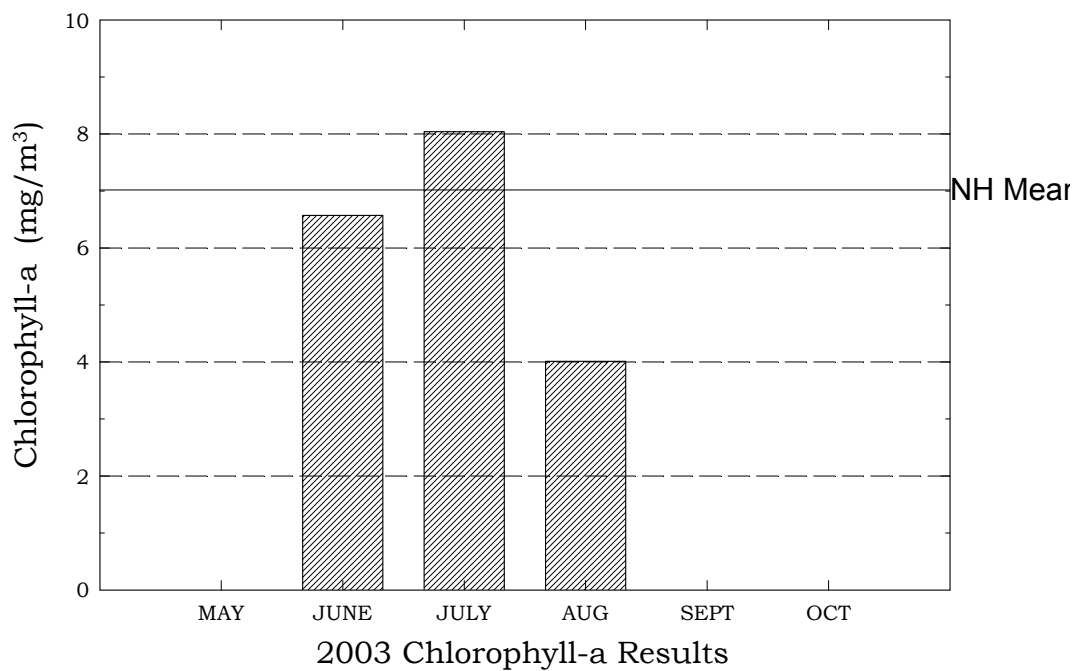
Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm.

APPENDIX A

GRAPHS

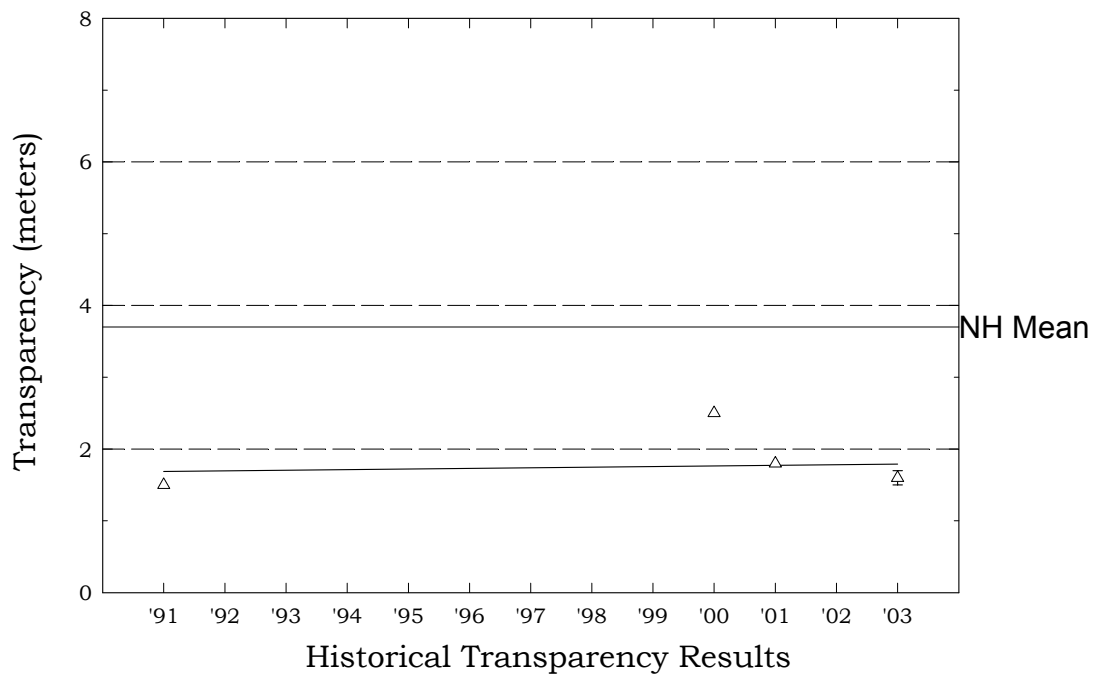
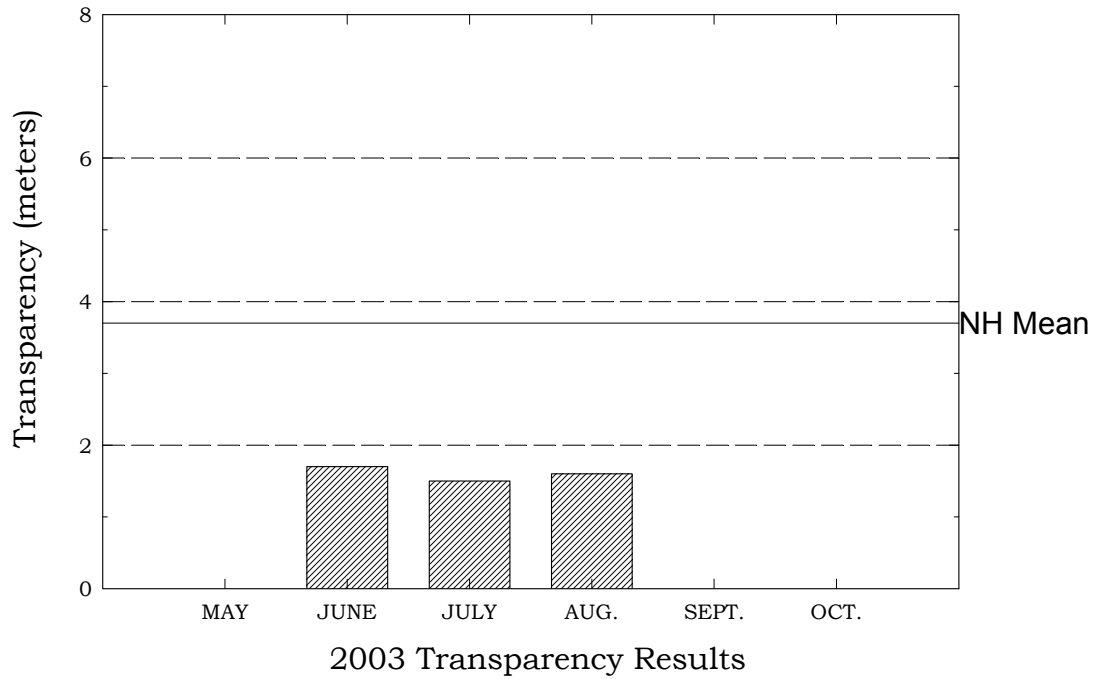
Shellcamp Pond, Gilmanton

Figure 1. Monthly and Historical Chlorophyll-a Results



Shellcamp Pond, Gilmanton

Figure 2. Monthly and Historical Transparency Results



Shellcamp Pond, Gilmanton

Figure 3. Monthly and Historical Total Phosphorus Data.

